



## Universal Radio Communication Tester CMU200

THE tester for current and future Mobile Radio Networks

- Multi-protocol support
- Extremely high speed testing
- Highly accurate measurements
- Modular futureproof design
- Comprehensive spectrum analyzer
- Growth into 3rd generation technologies

# Prepared for the 3rd generation

For more than 60 years Rohde&Schwarz has always been at the forefront of mobile radio technology. We continue this tradition of RF test and measurement with CMU200 Universal Radio Communication Tester. The CMU200 is a platform product that not only offers multi-mode functionalities for the prevailing successful first and second generation standards, but also promises the flexibility to cope with the digital mobile radio of the future.

The CMU200 reflects the long-standing expertise Rohde&Schwarz has gained in the world of mobile radio. In recent years, the company has helped to launch overwhelmingly successful mobile radio systems.

Rohde&Schwarz is a preferred supplier to many of the leading mobile equipment manufacturers and is the market leader for mobile radio test sets.

The CMU200 is part of a complete range of mobile radio test equipment, encompassing everything from type approval systems, to system simulators and a simple sales counter Go/NoGo tester.

Rohde&Schwarz offers the hardware and software necessary to handle your first and second generation applications. The CMU200 base unit with its standard-independent module test also provides measurement facilities for the development of the third generation standards due to evolve in the future. Ask your local Rohde&Schwarz representative to demonstrate the unit and to help determine your requirements.

## Low cost of ownership

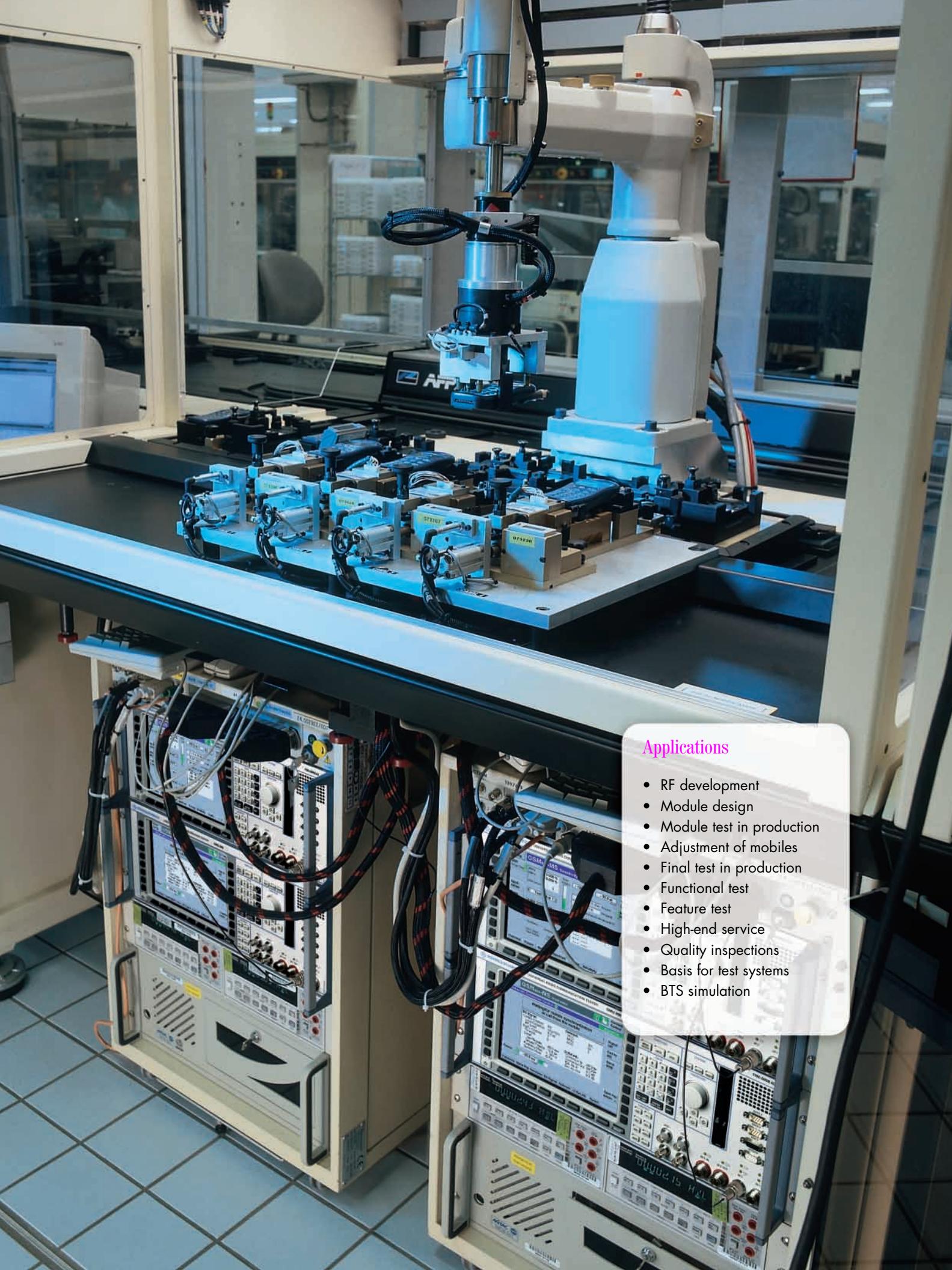
Selecting the CMU 200 is a decision for the future and grants a total cost of ownership which is sure to be amongst the lowest due to the following factors:

- The concept allows two complete channels (RF, signalling and evaluation) to be installed in one CMU200 mainframe
- Completely modular design of hardware and software components avoids having to buy an expensive package right from the start just because there is a possibility of a feature being needed sometime in the future. You only pay for what you need
- Should an extension become necessary because your applications widen after some time – the modularity of the CMU200 concept will cater for that. Extensions to the unit may be installed onsite. You only pay for it when you need it

- Maximum production output in a compact 4-height-unit package with minimum power dissipation
- The CMU200 front panel operation allows even less experienced users to intuitively get it right without the need for weeks of training.



The CMU200 targets a wide range of applications, but is primarily optimized for the high accuracy and speed demanded in an ever more quality-conscious manufacturing process



### Applications

- RF development
- Module design
- Module test in production
- Adjustment of mobiles
- Final test in production
- Functional test
- Feature test
- High-end service
- Quality inspections
- Basis for test systems
- BTS simulation

# Usability

## The CMU200 key strengths

### Radio Communication Tester

CMU200 brings premium cost effectiveness with a set of features where extremely fast measurement speed plus very high accuracy are the two most important ones. Complementing these, the secondary remote addressing of the unit's modular architecture makes for intelligent and autonomous processing of complete measurement tasks and fast control program design.

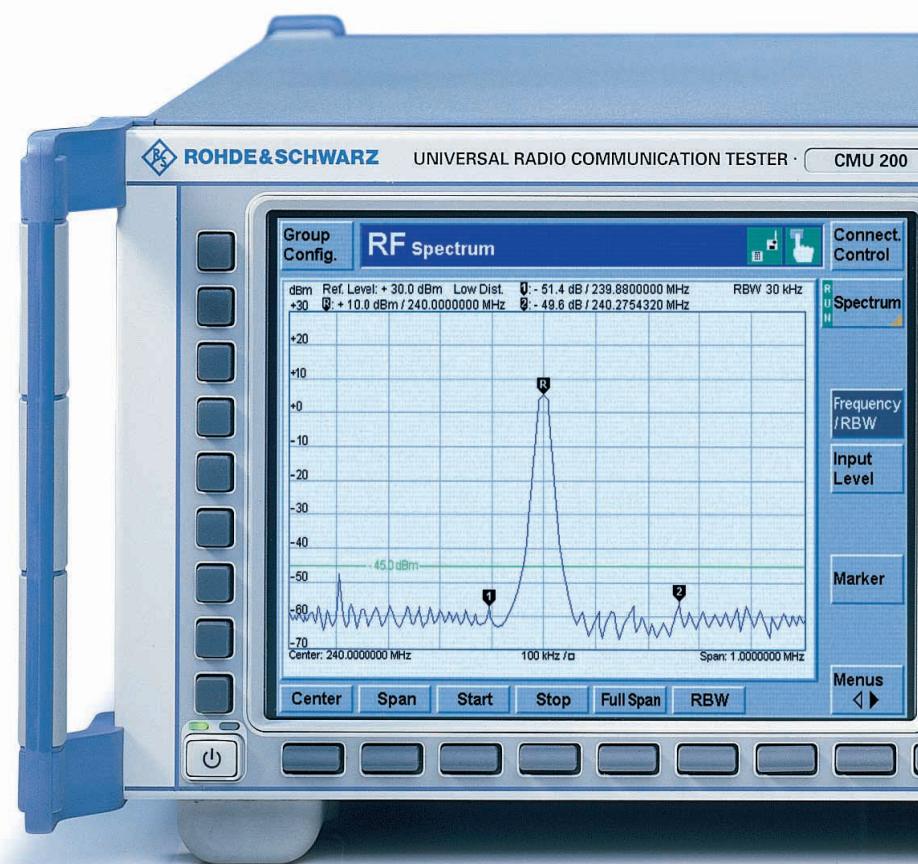
### Greatest accuracy

In production environments the unit's high accuracy allows DUTs to be trimmed for maximum battery lifetime without compromising quality. In the lab, CMU200 enables the development engineer to replace conventional, dedicated premium-quality instruments more often than any other radio communication tester and save desktop space at the same time.

The Rohde&Schwarz calibration system allows the CMU200 accuracy to be checked in a service center close to you or, volume permitting, on your site.

### Greatest speed

The high processing speed is due to extensive use of front-end DSP technology, parallel measurements and innovative remote command processing. These three aspects of the CMU200 performance are featured in more detail below.



- **Front-end DSP technology**

The modular architecture relies on decentralized ProbeDSP processing coordinated by a powerful central processor. Like an oscilloscope probe, DSPs dedicated to a specific local data acquisition and evaluation workload help to keep subsystem performance at an uncompromised maximum even if additional modules are fitted to the CMU mainframe.

- **Parallel measurements**

Several RX and TX measurements can be performed in parallel. This is achieved by the fast response of the CMU's modular hardware as well as the high overall processing power of the unit and the avoidance of bottlenecks by dedicated operation of the ProbeDSP technology employed. Examples of parallelization are measurements of BER and simultaneous burst power, phase/frequency, spectrum due to switching or spectrum due to modulation.

## Key advantages of the CMU



### Speed

- Single measurement up to 10 times faster than the current generation of instruments

### Accuracy

- Three times more accurate than the current generation of instruments with excellent repeatability

### Modularity

- Modular hardware and software concept provides easy extension to further functionality

### Future-proof

- Easy migration to future standards

- **Innovative remote processing**

The novel secondary addressing mode allows similar functions of each of the CMU200 subsystems (i.e. a signalling standard) to be addressed in an identical way.

Using this type of addressing, new remote test sequences can be programmed by a simple cut and paste operation with some specific commands to adapt the control program to the new application. Secondary addressing is fully SCPI-compliant which means that a subsystem address, like e.g. "GSM1800", can be replaced with a string denoting a different subsystem, i.e. another mobile radio standard.



# The base unit

Thanks to its modular architecture, the CMU200 base unit comes without any network- or standard-specific hardware and software.

The base unit without any options installed, may be used for testing general parameters of 1st, 2nd or 3rd generation mobile phones. The CMU200 base unit is the ideal solution for trimming tasks at module level, i.e. in early production stages of all cellular standards.

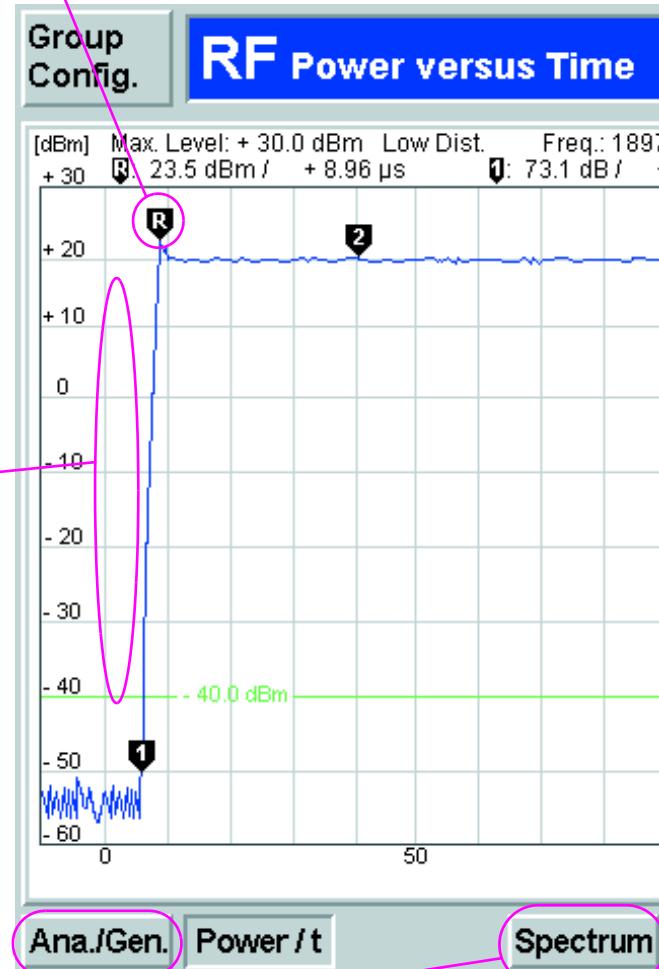
Constituent parts of the CMU200 base unit are the RF generator (100 kHz to 2.7 GHz) and analyzer which are complemented by a versatile network-independent analyzer/generator menu and a comprehensive spectrum analyzer. The power versus time measurement is shown on the right.

The rear-panel reference input and output allows to lock multiple units. It comes fitted as standard.

Advanced operational ergonomics have been incorporated into a compact and lightweight package.

Rohde & Schwarz devised a new standardized calibration system for the CMU200. It allows local or in-house calibration to be performed by our worldwide service network. In addition, your local Rohde & Schwarz representative will offer customized service contracts for the CMU200.

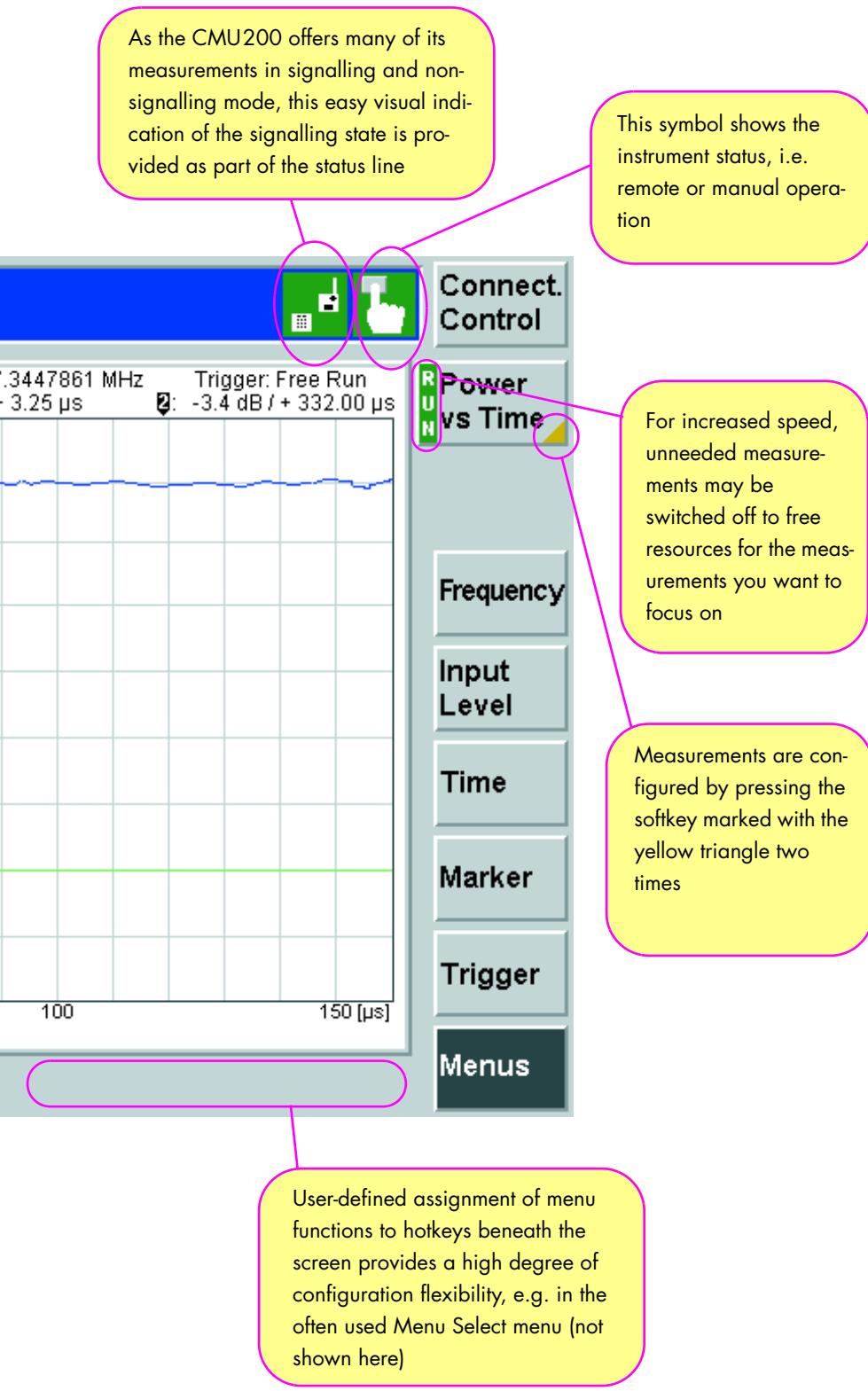
Thanks to the high resolution of the extremely bright high-contrast TFT display even the finest details can be displayed



Direct branching to all associated menus makes for a uniquely flat menu structure

The bright TFT display reproduced above shows the results of the built-in analyzer for the transient RF level of a phone's active timeslot in the power versus time mode.

Through the combination of graphical and numerical overview menus the optimal display can be chosen when CMU200 is in the manual mode.



The hierarchical menu structures used in conventional radio testers have been replaced by context-sensitive selection, entry and configuration pop-up menus.

## Prepared for tomorrow's networks

- Flexible input/output structure
- Wide frequency range from 10 MHz to 2.7 GHz suitable for all mobile radio standards
- Simple operation either manual or via IEC/IEEE bus
- Simultaneous RX/TX measurements
- Spectrum analyzer
- Bright high-resolution TFT colour display
- Testing of 1st, 2nd and 3rd generation mobile radio will be possible in a single unit with the W-CDMA extension
- Platform with multimode modular design
- Standard-specific software packages available for testing in accordance with present and future standards
- Network-independent non-signalling test for the development of new or existing standards facilitated by power versus time, RF analyzer/generator and spectrum analyzer measurements
- Worldwide service network
- Standardized calibration system for the instrument
- Low power consumption
- Low heat dissipation
- Easy 19" rackmounting
- Compact box of only 4 height units with award-winning industrial design



# Ready for today's networks ...

## The CMU200 – an investment for the future

Who says that the current data transfer capacity of GSM mobiles will be sufficient in the future?

Who says that GSM is only for the 400/900/1800/1900 bands?

The CMU200 platform is not only for today's standards and systems but is designed to meet the needs of tomorrow. The GSM concept enables e.g. multislot applications and offers furthermore the ability to apply GSM to the 400 MHz frequency band.

## GSM

Since its introduction in the early nineties, the GSM system has undergone an evolution that no one could have foreseen. The almost worldwide acceptance of GSM as the technology for mobile communication calls for a test instrument that offers the whole spectrum of possibilities.

The applications of the GSM system are numerous and are currently allocated to the GSM frequency bands:

- GSM400
- GSM900 including
  - P-GSM (primary GSM)
  - E-GSM (extended GSM)
  - R-GSM (railway GSM)
- GSM1800 (DCS)
- GSM1900 (PCS)

The application fields in which the CMU200 may be applied are diverse. Whether the application is in production, service or development, it calls for different tests and measurements to be performed, and the flexi-

ble concept of the CMU 200 provides the user with a tailored solution.

CMU200 functionality extends from basic RF signal generation, frequency, power and spectrum analyzer measurements for alignment of modules in production or development applications, to an instrument simulating a GSM base station for testing that requires the support of GSM-specific signalling in either of the above-mentioned bands, as well as module tests on frequencies anywhere in the range of 10 MHz to 2700 MHz.

The options required to support GSM signalling are based on the versatile Signalling Unit CMU-B21 and one or more of the software options CMU-K20, -K21, -K22 and -K23 that provide signalling in the GSM 400/900/1800/1900 bands.

The flat menu structure enables fast and efficient entry in dedicated measurement menus directly after a call setup, as well as an easy and quick change between the different measurement menus, in signalling and non-signalling mode alike.

### Signalling mode

The CMU200 simulates a GSM base station RF interface with the signalling flexibility necessary to test the behaviour of the mobile under the influence of different signalling parameters. These parameters are normally set by the network operator but can be reproduced by the CMU200 for test purposes. The unit supports the latest fast location update and direct paging features.

### Tolerant-signalling mode

The CMU200 provides the same functionality as in the *Signalling mode*, but

discards any signalling/reaction from the mobile connected. This mode of operation enables both testing of modules that only have layer 1 operation and very fast RF testing in production environments.

### Non-signalling mode

This mode serves for generating a signal with GSM-specific midambles and modulation in the entire frequency range from 10 MHz to 2.7 GHz. The analyzer offers the same flexibility for GSM-specific measurements such as

- phase/frequency error
- power
- power versus time
- spectrum

### GSM development

As an all-round tool for GSM development engineers, the CMU 200 is an unsurpassed solution. The RF interface provides four input and output connectors offering a wide range of signal levels for generation and analysis of RF signals. Input only as well as combined input/output connectors afford analysis of mobiles or modules with a sensitivity down to -80 dBm and up to +47 dBm for the power meter. RF signals may be generated with levels from -130 dBm up to +13 dBm, depending on the selected connector. All measurement tolerances are set by default according to the 11.10 and 05.05 recommendations but may of course be altered to suit individual needs. Immediately after the instrument has been switched on, user-definable hotkeys provide a fast and easy shortcut to frequently used functions, measurement results and configuration tables, presented on the clear RF-shielded 8.4" colour TFT display.

GSM-specific module test provides generation and analysis of RF signals for testing of RX/TX modules or mobiles in service mode

### Quality assurance

For quality assurance applications, the CMU200 offers the possibility of in-depth analysis as well as the high level of accuracy and repeatability expected of a high-end test instrument.

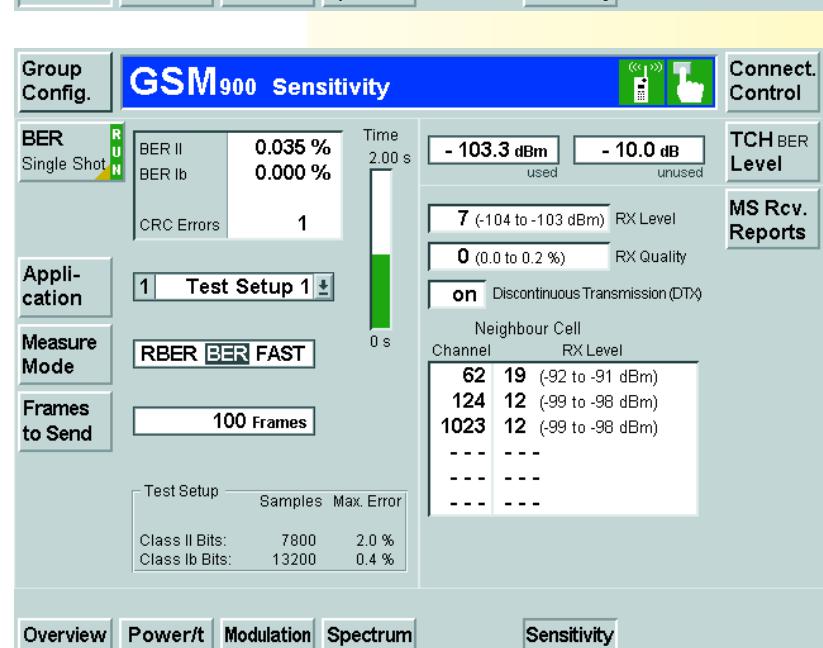
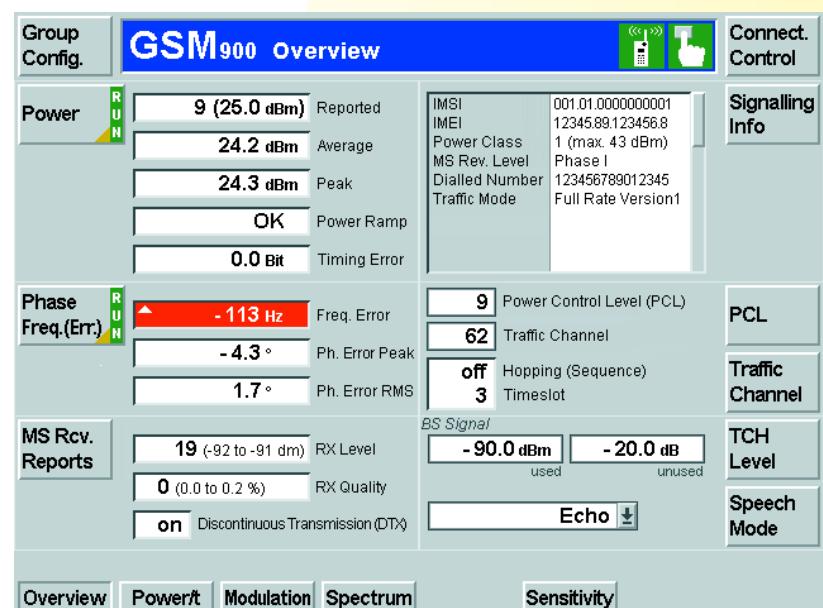
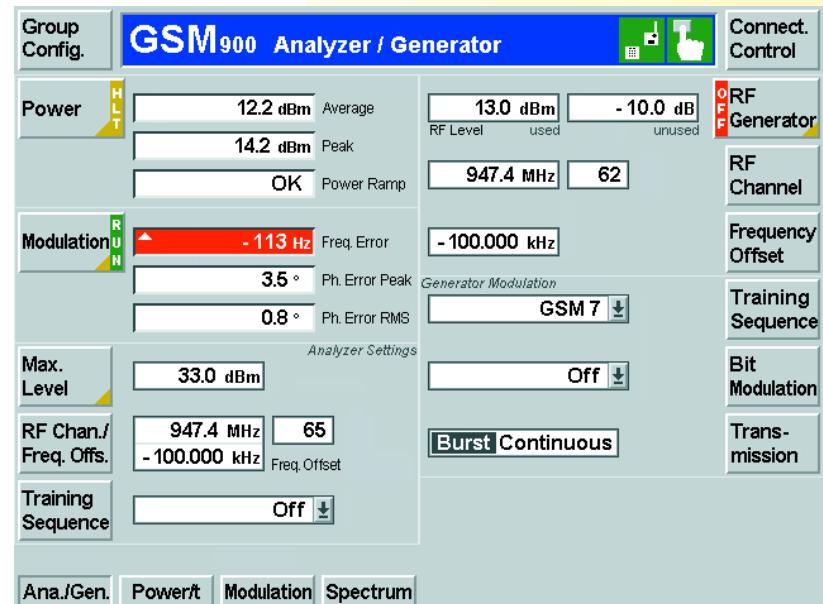
Tests such as simulation of specific GSM networks and dual-band handover with the corresponding signalling parameters are possible due to the comprehensive signalling configuration capabilities. GSM-specific measurements of phase and frequency error or power versus time are all available at a key-stroke. For analysis of the receiver performance, BER, RBER/FER and burst by burst as well as a BER search for absolute sensitivity verification are available with up to 10 user-definable settings.

### Production of mobile telephones

Production is a process that calls for cost effectiveness. The CMU200 concept is optimized for IEC/IEEE-bus speed, measurement accuracy and reproducibility as well as cost of ownership. Thanks to the multi-tasking feature and parallel measurements previously unobtainable test times can be achieved.

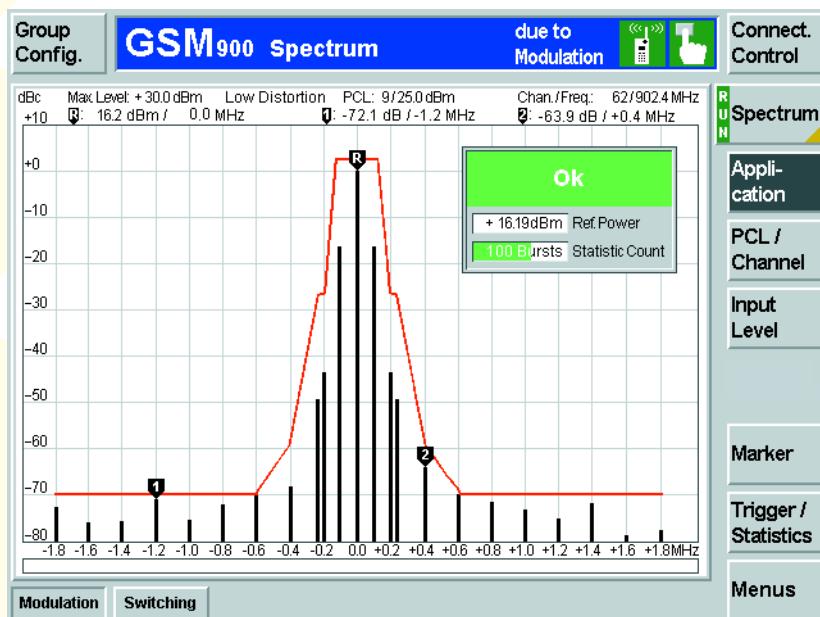
The ability to process BER data and perform transmitter measurements at the same time, allows phase / frequency error, power versus time and average power (PCL accuracy) to be measured during the time-con-

The overview menu provides fast comprehensive information on the mobile's RF performance. The hotkeys at the bottom of the screen give immediate access to specific and detailed GSM measurements



# ... and prepared for tomorrow

suming receiver test. Due to the intelligence of the CMU200 the order of measurements can be arranged so as to achieve the maximum efficiency and thus minimize test times. In case of time-consuming measurements where a statistical value is a valid indication, it is possible to fetch results during the measurement run. The measurement may be stopped if a satisfactory result has been obtained which saves valuable time. The accuracy and reproducibility ensure correct and steady measurement results and thus contribute to the quality and reliability of the end product.



GSM-specific measurements of spectrum due to *switching* and *modulation* are available during a call with no additional hardware or instrumentation needed. Compliance with GSM recommendations or user-defined tolerances are available as *PASS/FAIL* decision as well as detailed measurement results



## GSM specifications

### RF generator GSM

**Frequency range**  
GSM900 band  
GSM1800 band  
GSM1900 band

925 MHz to 960 MHz  
1805 MHz to 1880 MHz  
1930 MHz to 1990 MHz

**Frequency resolution**  
GSM channel spacing  
**Frequency uncertainty**  
**Frequency settling time**

200 kHz  
same as time base  
<500 µs to res. phase of 4°

**Output level**  
RF1  
RF2  
RF3OUT

-130 dBm to -27 dBm  
-130 dBm to -10 dBm  
-90 dBm to +13 dBm

**Level uncertainty**  
RF1, RF2  
in temperature range  
+23°C to +35°C  
+5°C to +45°C

P > -117 dBm  
0.5 dB  
0.7 dB

RF3OUT  
in temperature range  
+23°C to +35°C  
+5°C to +45°C

P > -90 dBm to +10 dBm  
0.7 dB  
0.9 dB

**Attenuation of inband  
spurious emissions**

>50 dB

**Modulation**

GMSK, BxT = 0.3

**Inherent phase error**

≤1°, rms  
≤4°, peak

### RF analyzer GSM

**Frequency range**  
GSM900 band  
GSM1800 band  
GSM1900 band

880 MHz to 915 MHz  
1710 MHz to 1785 MHz  
1850 MHz to 1910 MHz

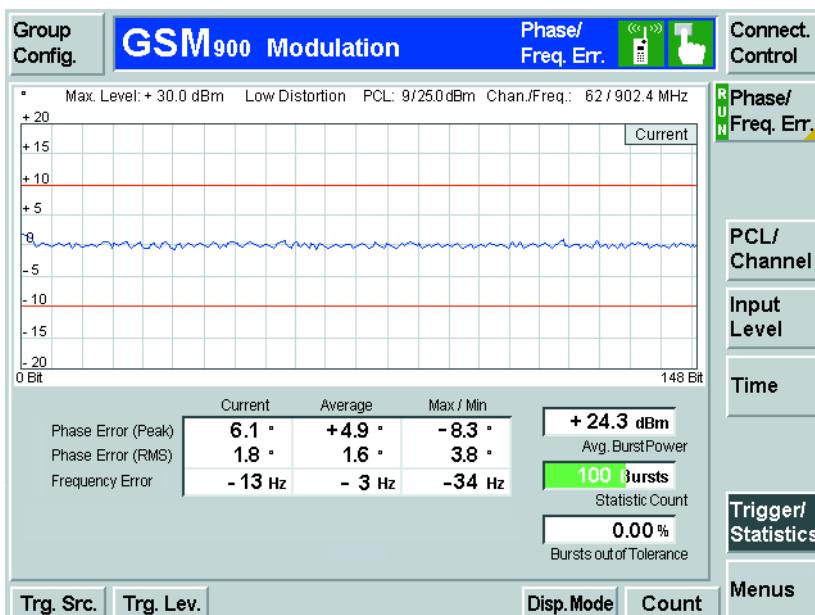
**Frequency resolution**  
GSM channel spacing

200 kHz

**Measurement bandwidth**  
in measurement menus

500 kHz

## GSM highlights of CMU200



The performance of the GSM mobile or module synthesizer is monitored in the phase and frequency error menu. A pass / fail verdict is immediately available due to red colouring of those measurement results that are outside the user-configurable limits. Statistical evaluation of measurement results over up to 1000 bursts as well as stop-on-error conditions ease the task of assessing a product in any application.

**1996 CRTP/C02** Approved as stand-alone tester for type approval of phase II GSM900/1800 mobiles.

**1997 TS8915** Supplier of the first type-approval system for GSM1900.

**1997 CMD65** The world's first compact digital radiocommunication tester for GSM900/1800/1900 and DECT.

**1999 CMU200** THE tester for current and future mobile radio networks.

### Benchmark-breaking IEEE-bus speed due to

- Parallel measurements
- Secondary addressing
- Optimized processing power

### Base station simulation including

- BS\_AG\_BLK\_RES, BS\_PA\_MFRMS, DTX, cell access, MCC, MNC, NCC, BCC, location area, BA list, hopping, radio link timeout for mobile/base station, AOC

### More features

- Location update with registration of IMEI and IMSI
- Call to/from mobile
- Call termination from mobile /network
- Channel handover
- Timeslot handover
- Power control level handover
- Dual-band handover
- BCCH, SACCH, SDCCH, FACCH, TCH

### Measurements

- Phase / frequency error
- Power versus time normal/access
- Peak/average power
- BER, RBER/FER, FastBER (burst by burst)
- General spectrum measurements
- Timing error

#### Power meter GSM

##### Level range for rated data

RF1	continuous power <sup>1)</sup>	-40 dBm to +47 dBm (50 W)
	max. peak power <sup>2)</sup> (PEP)	+53 dBm (200 W)
RF2	continuous power	-54 dBm to +33 dBm (2 W)
	max. peak power <sup>2)</sup> (PEP)	+39 dBm (8 W)

RF4IN (continuous power and PEP) -80 dBm to 0 dBm

##### Level uncertainty

RF1, RF2, RF4IN in temperature range +23°C to +35°C	0.5 dB
+5°C to +45°C	0.7 dB

##### Resolution

0.1 dB

#### Phase and frequency error measurement GSM

##### Level range (PEP)

RF1	-6 dBm to +53 dBm
RF2	-20 dBm to +39 dBm
RF4IN	-60 dBm to 0 dBm

##### Inherent phase error

≤0.6°, rms  
≤2°, peak

##### Frequency measurement error

≤10 Hz + drift of time base

##### Burst power measurement GSM

##### Reference level for full dynamic range

RF1	+10 dBm to +53 dBm
RF2	-4 dBm to +39 dBm
RF3IN	-22 dBm to 0 dBm

##### Dynamic range

>72 dB, rms

##### Relative measurement uncertainty

Result >-40 dB  
-60 dB ≤ result ≤ -40 dB

≤0.1 dB  
≤0.5 dB

##### Resolution

0.1 dB in active part of burst

<sup>1)</sup> 50 W from +5 °C to +30 °C, linear degradation down to 25 W at 45 °C.

<sup>2)</sup> Mean value of power vs time must be equal or less than allowed continuous power.

# Models and options

## Instruments options and ordering information

Type/ Option	Description	Development & QA	Production	High-end service	Order number
<b>CMU200</b>	Base unit with the following accessories power cord, operating manuals and service manual, fuses	☺	☺	☺	1100.0008.02
<b>CMU-B11<sup>1)</sup></b>	Reference OCXO, aging $2 \times 10^{-7}$ /year. Ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability. Used for measurements with exacting frequency stability requirements	✓	✓	✓	1100.5000.02
<b>CMU-B12<sup>1)</sup></b>	High-stability OCXO, aging $3.5 \times 10^{-8}$ /year. Oven crystal with highest long-term stability. Ensures compliance with tolerances specified by GSM. Used for highly demanding frequency stability requirements to GSM 11.20	☺	✓	☺	1100.5100.02
<b>CMU-B21</b>	Versatile signalling unit board. Provides multistandard signalling hardware	☺	☺	☺	1100.5200.02
<b>CMU-B41</b>	Audio generator and analyzer. Includes audio frequency (AF) generator, voltmeter, distortion meter	☺	☺	✓	1100.5300.02
<b>CMU-B52</b>	Internal versatile multimode speech coder/decoder. This option converts digital speech signals into analog signals and vice versa. The option allows separate uplink and downlink audio application measurements on phones of different standards	☺	☺	☺	1100.5400.02
<b>CMU-U61</b>	Modification kit: Floppy disk drive 3 1/2" instead of PCMCIA	-	-	-	1100.5500.02
<b>CMU-K20<sup>2)</sup></b>	GSM400 mobile station signalling/non signalling test	☺	☺	☺	1115.5900.02
<b>CMU-K21<sup>2)</sup></b>	GSM900, R-GSM and E-GSM mobile station signalling/non signalling test	☺	☺	☺	1115.6007.02
<b>CMU-K22<sup>2)</sup></b>	GSM1800 (DCS) mobile station signalling/non signalling test	☺	☺	☺	1115.6107.02
<b>CMU-K23<sup>2)</sup></b>	GSM1900 (PCS) mobile station signalling/non signalling test	☺	☺	☺	1115.6207.02
<b>CMU-DCV</b>	Documentation of calibration values	☺	☺	✓	0240.2193.08
<b>CRT-Z2</b>	Test SIM to enable a loop-back mode as required for BER and other applications	☺	☺	☺	1039.9005.02
<b>CMU-Z1</b>	32 MB Memory card for use with PCMCIA interface	☺	✓	☺	1100.7490.02
<b>PSM-B9</b>	PCMCIA Type 3 min. 260 MByte Hard Disk	☺	✓	☺	1064.5700.02
<b>ZAA-411</b>	19" Rack adapter 4HU 1/1	-	☺	✓	1096.3283.00

### Comments on table:

☺ highly recommended; ✓ recommended

<sup>1)</sup> CMU-B11 or CMU-B12 possible. One of two OCXOs should be installed to ensure high frequency accuracy or external frequency reference may be used, if available.

<sup>2)</sup> CMU-B21 necessary.

## Fax Reply (Universal Radio Communication Tester CMU200)

- Please send me an offer
- I would like a demo
- Please call me
- I would like to receive your free-of-charge CD-ROM catalogs

Others: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_

Company/Department: \_\_\_\_\_

Position: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Country: \_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_



## Value-added services

- Rohde&Schwarz offers a wide range of training programs not only on products but also on new technical developments
- Rohde&Schwarz application engineers help to optimize the use of CMU200 and the overall performance of your local environment
- Over 70 representative offices and a tight worldwide network of service and calibration centers ensure Rohde&Schwarz support where you need it

## Quality management

### at Rohde&Schwarz

Lasting customer satisfaction is our primary objective. The quality management system of Rohde&Schwarz meets the requirements of ISO 9001 and encompasses virtually all fields of activity of the company.

Certified Quality System

**ISO 9001**

DQS REG. NO 1954-04

**Basics**

**Technology**

**GSM**

available now!

**IS136**

available soon

**AMPS**

available soon

**CDMA**

available soon



**Bluetooth**

planned

**W-CDMA**

planned